Comparison of Software-Assisted and Freehand Methods of Rotational Assessment for Diaphyseal Femur Fractures

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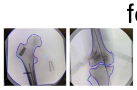
INTRODUCTION: Rotational reduction following femoral shaft fracture fixation is inadequate in up to 28% of cases, yet is critical for lower extremity biomechanics. The objective of this cadaveric study was to compare the results of freehand methods of reduction with software-assisted reduction.

METHODS: Five matched pairs of hip-to-toe cadaveric specimens without a history injury were obtained. A transverse osteotomy was then performed to simulate a midshaft femur fracture, a guidewire was inserted, and previously placed Schanz pins were randomly manipulated to simulate malrotation about the fracture. Four fellowship-trained orthopaedic trauma surgeons attempted rotational correction with fluoroscopic assistance using 1) their method of choice (MoC) and 2) software assistance (SA). After correction, deviation from baseline rotation was calculated.

RESULTS: The mean malrotation after correction was 9.1° with MoC and 8.0° with SA. There was no significant difference in the mean value between methods, but SA had significantly less variability compared to MoC. The mean difference between the two methods (MoC – SA) was 1.1°, which was not significant when comparing all raters and between raters individually. The rate of clinically relevant rotational deformity (i.e., > 20°) was 20% using MoC and 5% using SA.

DISCUSSION AND CONCLUSION: Rotational assessment of diaphyseal femur fractures in a cadaveric model was adequate with both MoC and SA. SA led to significantly less variability in rotational deformity and fewer clinically relevant rotational deformities. Based on this cadaveric study, SA is a promising tool to augment current techniques for assessing rotational following femoral shaft fracture reduction.



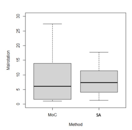


Table 1: Demographics and Baseline Version

Specimen Number	Sex	Age at Death (years)	Left Antetorsion (degrees)	Right Antetorsion (degrees)	Antetorsion Difference (Left - Right)
1 & 2	Female	89	5	21	-16
3 & 4	Female	55	-1	6	-7
5 & 6	Female	83	29	24	5
7 & 8	Male	74	23	7	16
9 & 10	Female	75	-4	-8	4

Bolded numbers are the "injured" laterality

Table 2: Rotational Deformity with Method of Choice

Specimen	Surgeon 1	Surgeon 2	Surgeon 3	Surgeon 4	Average
1	6.1°	27.4°	23.2°	13.9°	17.6°
3	11.1°	1.2°	9.8°	20.3°	10.6°
6	1.4°	9.0°	1.2°	5.6°	4.3°
7	1.8°	2.4°	6.1°	1.5°	2.9°
9	1.0°	14.0°	19.7°	5.9°	10.1°
Average	4.3°	10.8°	12.0°	9.4°	

Table 3: Rotational Deformity with Software Assistance

Specimen	Surgeon 1	Surgeon 2	Surgeon 3	Surgeon 4	Average
1	10.3°	4.2°	11.7°	11.2°	9.3°
3	6.9°	7.8°	10.3°	1.7°	6.7°
6	11.9°	12.0°	2.7°	3.8°	7.6°
7	6.2°	8.9°	1.3°	6.6°	5.7°
9	4.0°	6.9°	17.8°	14.7°	10.8°
Average	7.8°	7.9°	8.7°	7.6°	

Table 4: Method of Choice vs. Software Assistance by Surgeon

Surgeon	Mean Difference (Metho of Choice – Software Assistance)	Standard Deviation
1	-3.5°	5.2°
2	3.0°	12.6°
3	3.3°	5.2°
4	1.8°	10.5°

Table 5: Method of Choice vs. Software Assistance by Specimen

Specimen	Mean Difference (Method of Choice- Software Assistance)	Standard Deviation
1	8.3°	11.8°
3	4.0°	10.7°
6	-3.3°	5.2°
7	-2.7°	5.0°
9	-0.7°	6.8°